He was thus led to examine the properties of the surface of constant negative curvature, to which he gave the name of *pseudosphere*, and the geometry of such a surface was found to be identical with the geometry of Gauss and Lobatschewsky. As his old pupil and successor at Pavia, Prof. Carlo Somigliana, remarks, "It can thus be said that although the germs of his results can be traced back to some of his predecessors, and, in particular, can be found in the profound considerations of Riemann, and other advances have come subsequently, yet his work represents and synthesises the most decisive step that has been made in modern times by the geometric conception of real space."

Nor was the "Saggio d'interpretazione" by any means Beltrami's only contribution to mathematical literature at the period under consideration. We find him extending the properties of surfaces of constant curvature to n dimensional space; and his papers on differential parameters, on the flexure of ruled surfaces, and on the general theory of surfaces, published a few years previously to the "Saggio," are well known to mathematicians.

In 1873, Beltrami migrated to Rome as professor of rational dynamics and higher analysis, and was elected a Fellow of the Italian equivalent of our Royal Society, the Reale Accademia dei Lincei. His sojourn in Rome was of brief duration; for, much to the regret of his friends there, he went to Pavia in 1876, where he lectured on mathematical physics and higher mechanics, and it was not until 1891 that an opportunity offered itself for him to return to Rome. It was only two years ago that Beltrami was prevailed on to accept the office of President of the "Lincei," and last year he was unanimously elected to the senatorial rank. As a general rule, however, he avoided all public appointments, and the only other post he held was on the Italian Council of Education. He preferred to devote his entire energies to the studies in which he was interested, and sought no scientific distinctions; still, the laurels which he had well earned were freely showered on him by the academies of Bologna, Lombardy, Turin, Naples, Paris, Göttingen, Brussels, Munich and Berlin; and the London Mathematical Society was also proud to place his name on its list of foreign mathematicians.

We have hitherto spoken chiefly of Beltrami's work as a pure mathematician, but his later investigations tended more especially in the direction of applied mathematics. Hydrodynamics, theory of potential, elasticity, physical optics, electricity and magnetism, conduction of heat and thermodynamics were all made the subject of papers, each of which "shed a bright light on some difficult or controversial point." In the theory of the potential considerable simplifications of method were made, and the papers on potentials of symmetric distributions and on the attractions of ellipsoids are described by Somigliana as "true models of classical elegance." In the theory of elasticity, Lamé's equations were shown to be intimately related to the euclideity of space, and the generalisations for spaces of constant curvature opened up a new field for research, of which Beltrami endeavoured to make use in accounting for the uncertainties in Maxwell's theory, which substitutes action in a continuous medium for action at a distance.

The last period of his researches was devoted to developing Maxwell's theories of electro-magnetic phenomena, a difficult task, for which Beltrami's mathematical knowledge well fitted him. All who have read Maxwell's treatise realise that it contains many obscure points and demonstrations of hardly a rigorous nature, and most of those who have failed to follow his arguments have preferred to regard the results as statements of Maxwell's views, rather than inquire into the validity of the reasoning on which they were based. Beltrami, on the other hand, being well versed in the art of exact expression and the elegances of neatness of analytical form, was not contented with Maxwell's rough-and-ready methods, but devoted long hours of deep thought to co-ordinating and perfecting the ideas which he regarded as incomplete. Among his latest contributions to the *Atti dei Lincei* we notice a paper on thermodynamic potentials published in 1895.

As a professor, Beltrami's lectures are said to have been characterised by the same perfection of style and exactness of form which are so conspicuous in his writings. His genial manner and high culture made him a centre no less in general society than in the scientific world. Shakespeare's epithet, "Cunning in music and in mathematics" well applies to Beltrami, and we learn from Signor Pietro Cassani's obituary address to the Venetian Academy, that having been taught music in his early days by his mother, and afterwards under Ponchielli, he would often delight his friends by his renderings on the piano of the masterpieces of Bach, Mendelssohn and Schumann.

The life that has been brought to such a sad close must have been in many respects an ideal life. Beltrami had every opportunity for devoting himself to the studies which he chose as his life's work; he knew nothing of rivalries and petty jealousies, as he made no enemies; but, on the other hand, we cannot but suppose that his experience of the necessities of making the best of somewhat uncongenial surroundings during his years of railway work had a beneficial influence on his after life, in preventing Beltrami from attempting to live up to a false ideal. His loss adds another to the many gaps in the mathematical world, but his published works form a fitting memorial of their author, and several of them bid fair to be handed down to posterity among the mathematical classics.

We are indebted to Prof. Blaserna, of Rome, for much valuable information on which this account is based.

G. H. BRYAN.

PROF. ST. GEORGE MIVART.

BY the sudden death, at the age of seventy-two, of Prof. St. George Mivart, the world in general and science in particular are distinctly the poorer. For he was essentially a many-sided man; and although an energetic and accurate investigator in several branches of biology, was in no sense a specialist whose efforts were restricted to the elucidation of abstruse facts or the elaboration of theories in which the general public could take little or no interest. On the contrary, ever since 1870, when he first began to contribute to the higher grade of popular reviews, he has kept himself constantly in evidence, and has thus become known to a very wide circle of readers, especially as the apostle of the evolution of organic nature under divine guidance.

St. George Mivart was born at his father's house in Brook Street, Grosvenor Square, on November 20, 1827. He was educated successively at Clapham Grammar School, Harrow, King's College, London, and St. Mary's College, Oscott; his adoption, in 1844, of the principles of the Romish faith being at that time a bar to his matriculating at Oxford, where it was his father's intention that his education should have been completed. In 1851 he was called to the Bar at Lincoln's Inn, but his legal career, if he ever practised at all, was a brief one; and in a short time his attention was concentrated first on medical and later on biological studies. By 1862 Mivart had made such a reputation in medico-biological studies that he was appointed a lecturer at the Medical School of St. Mary's Hospital. Previously to this, in 1885, he became a Fellow of the Zoological Society, of which body he was elected a Vice-President in 1869, and again in 1896; indeed, he continued in the latter office

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till 1899, when he was compelled by ill-health to resign. In 1869 his merits were recognised by admission to the Fellowship of the Royal Society. He was likewise a Fellow of the Linnean Society of London, of which body he was Secretary from 1874 to 1880, while he subsequently served for many years on its Council, and at one time as a Vice-President. In 1874 he was appointed Professor of Biology at University College, London. In 1876 he was created a Ph.D. of Rome by the Pope, while in 1884 the degree of M.D. was conferred upon him by the University of Louvain. Subsequently he was nominated Professor of the Philosophy of Biology in the last-named University.

Although various scientific memoirs had previously appeared from his pen, it was in 1870 that Dr. Mivart made his first appearance as an essay-writer in popular reviews; and from that date onwards communications of this nature in the *Quarterly*, *Fortnightly*, and *Contemporary Reviews*, and the *Nineteenth Century*, have made his name a household word. All these were marked not only by conspicuous originality of view, but likewise by a high degree of literary and controversial merit. It is not, however, these communications that it is our present intention to describe. With the appearance, in 1871, of "The Genesis of Species" (two editions of which were issued during the first year of its existence), Dr. Mivart may be said to have first come into prominent public notice; and the attention it attracted may be gathered from the criticisms which it drew from Prof. Huxley and other distinguished evolutionists. As is well known, the author in this volume seeks to put natural selection somewhat in the background as a factor in the evolution of animal life, and to bring into prominence the guiding action of Divine power. An advocate for "creation," the author was careful to distinguish between *absolute* and *derivative* creation; stating that it was with the latter alone that the evolutionist had to deal. At the same time he laid stress on the opinion that while man's body was the result of evolution, the origin of his intellect must be sought elsewhere.

The elaboration of his views as to the relationship existing between human intellect and animal nature in general was given first in "Nature and Thought; an Introduction to Natural Philosophy" (1882), and finally in "The Origin of Human Reason" (1889), as well as in various serial articles.

But on these and kindred subjects Dr. Mivart could not have spoken with authority unless he possessed an accurate knowledge of the physical relationships between man and the other Primates, as well as those between the latter and the lower Vertebrates. And, in 1873, the appearance (in Macmillan's "School Class Books") of "Lessons in Elementary Anatomy," and also of a separate essay on "Man and Apes," showed how wide a grasp the author had obtained of Vertebrate anatomy generally, and of that of the Primates in particular. Within such a small compass as the "Lessons," there are few, if any, works where the student can gather such an amount of information.

Dr. Mivart's great interest in the Primates led to his being asked to contribute the article "Apes" to the ninth edition of the "Encyclopædia Britannica"; and the excellence of that essay led, with the author's permission, to the incorporation of its substance in "The Study of Mammals," by Flower and Lydekker. To the same great undertaking Dr. Mivart also contributed the articles "Skeleton" and "Reptiles." The latter article showed that, although the author devoted much of his attention to the anatomy of Mammals, yet that other groups of Vertebrates engaged a considerable portion of his energies. During the seventies, for instance, he published in the *Trans. Zool. Soc.* a "Memoir on the Axial Skeleton of the *Struthionidae*," a second on that of the *Pelecanidae*, and a third dealing with the structure of the fins of the Elasmobranch fishes, and the nature and homologies of Vertebrate limbs generally. The first of these three is an important contribution to our knowledge of the osteology of the Ratite Birds, being even at the present day an epitome of the greater portion of our information on this subject. And his devotion to Avian anatomy continued to occupy much of his attention even in his later years, as is attested by his papers on the bony structure of certain Lories and Parrots which appeared in the *Proc. Zool. Soc.* for 1895 and 1896. In 1892 appeared a small volume on "The Elements of Ornithology," in which Dr. Mivart gives his views on the vexed question of Avian classification. In this he follows, to a great extent, the system proposed by the late Mr. Seebohm.

To revert to his favourite study of Mammals, in the sixties Dr. Mivart was much occupied with the anatomy of the Insectivora, the results of his work being published in the *Journ. of Anatomy and Physiology* for 1867 and 1868, and in the *Proc. Zool. Soc.* for 1871. Subsequently his attention was turned to the Carnivora, and the year 1881 was signalised by the appearance of his work, entitled "The Cat; an Introduction to the Study of Backboned Animals, especially Mammals." To a great extent this volume was modelled on the lines of Huxley's "Crayfish," published a year earlier. And it affords an admirable example of how the detailed study of one particular animal may be made the starting-point of a general survey of its near and remote kindred.

The study of the anatomy of the Cat naturally led Dr. Mivart to devote his attention to that of the other Carnivora; and in 1882 two papers dealing with the classification, distribution, and anatomy of the Æluroid Carnivora were published by him in the *Proc. Zool. Soc.* Three years later (1885) these were followed by a memoir in the same serial, in which the Arctoid Carnivora were dealt with in a similar manner. The amount of detailed work in these three papers, and the elaborate manner in which it is classified and arranged, is worthy of all admiration, and renders them a mine of information for the anatomist. Unfortunately the author paid no attention to the palæontological aspect of the subject, and was accordingly unaware how essentially false and misleading is the division of the Carnivora into the Æluroid, Cynoid, and Arctoid groups.

After devoting so much time to the study of the first and third of these groups, Dr. Mivart turned his attention to the third; and in 1890 three papers on the *Canidae* made their appearance in the *Proc. Zool. Soc.* In the same year the quarto "Monograph of the *Canidae*" saw the light.

To this long list of literature, which only embraces a portion of Dr. Mivart's work, it must suffice to add that a small but useful little volume from his pen, entitled "Types of Animal Life," made its appearance in 1893.

The result of all the work bestowed on the Carnivora and Insectivora was largely to increase our knowledge of the anatomy of these groups; the most remarkable feature connected with these investigations being the care bestowed on the arrangement and tabulation of the data acquired. In this respect Dr. Mivart's work is a model for future investigators.

As a lecturer, Dr. Mivart was frequently before the public, both at the Zoological Gardens and at the London Institution; and he had that charm of manner and intonation which could surround with a halo of interest even the driest and apparently most unpromising subjects of zoological research. This charm of manner—largely due to a suave and old-fashioned courtliness which survives only in a few instances at the present day—was equally conspicuous in the ordinary intercourse of life. And to all who enjoyed the privilege of his acquaintance and friendship, his cordial greeting—whether when acting in the *rôle* of host, or at a casual meeting—will long survive as a pleasant memory of a remarkable and distinguished personality.

R. L.

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